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NAVAL POSTGRADUATE SCHOOL

IN REVIEW MAGAZINE

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RETURN TO DOMINANCE

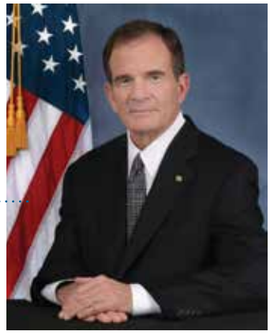
WHAT WAS ONCE A POWERFUL ADVANTAGE FOR THE U.S. FADED WITH THE END OF THE COLD WAR. BUT DOMINATION IN THE UNDERSEA DOMAIN IS BACK, AND NPS' 40 YEARS IN USW EDUCATION IS PAYING OFF NOW MORE THAN EVER.

INSIDE:

Ph.D. Student Researches Privatization of Peacekeeping

University Advances Materials Research on Campus

New Educational Programs Focus on Civil Affairs Officers



Daniel T. Oliver
Vice Adm., United States Navy (Ret.)
President, Naval Postgraduate School

NPS is deeply rooted in advancing the combat effectiveness of the U.S. Armed Forces, and of our closest allies. This sentiment is the anchor of the NPS mission, and it is the single, guiding vision in every curriculum, every research program, every certificate and short course … In short, in everything we do.

PRESIDENT'S MESSAGE

Late October finds campus leadership preparing for the biannual meeting of the Board of Advisors — an advisory body of visionaries across the spectrum of defense, industry and academia that provides invaluable strategic oversight to NPS. As presentations and materials are gathered for the Board, we are faced with an intriguing question … What makes NPS relevant?

In truth, the answer lies within nearly everything we do, for unlike any other graduate level university, NPS is deeply rooted in advancing the combat effectiveness of the U.S. Armed Forces, and of our closest allies. This sentiment is the anchor of the NPS mission, and it is the single, guiding vision in every curriculum, every research program, every certificate and short course … In short, in everything we do.

Periods of great fiscal challenge, however, lead to advanced scrutiny, and it is a well-deserved examination for any organization placed in the honored position of the public trust. Our institution must be held to the highest of standards, and while the answer to that question may very well be everything we do, it's the follow-up that is indeed much more potent … *Prove it.*

Fortunately, proof is something we are not short of when it comes to relevance, and one need to look no further than the pages of this edition of "In Review" for definitive, undeniable evidence that the Naval Postgraduate School is truly providing educational and research programs that no other institution can.

For example, a collaborative effort between key faculty and leadership from the NPS Departments of Mechanical and Aerospace Engineering, and Physics, has led to the rapid deployment of a very sophisticated, robust effort in the critical field of materials sciences. The addition of a core group of top young faculty, along with their advanced research and expertise, has provided the university and our students with an immense bounty in this critical field. The subsequent establishment of our Center for Materials Research has completed the effort, providing the facilities and technology needed to truly advance knowledge in this discipline for decades to come.

Another effort in a very unique educational space is paying great dividends to a critical officer community, while simultaneously showing wonderful potential for future expansion. The civil affairs officer is an integral component to maintaining peace and preventing conflict in today's complex environment, and two Naval Postgraduate School graduate-level certificate programs are rapidly preparing these officers for success. The program has been very well received within the community, and is only beginning to leave its potential mark on America's national security goals and initiatives.

And finally, another element of undeniable proof lies not in a new effort, but in a long-standing one. The undersea domain had been forever dominated by the United States, and following the close of the Cold War, was thought to be an area where American superiority would last forever. Developments in technologies, and a changing world stage, have demonstrated that only true focus and sheer will, can keep America at the top of the ocean's deep blue.

The Naval Postgraduate School's Undersea Warfare curriculum has been in operation since the 1970s, and has been gaining momentum as defense leadership, especially within the Navy, realize that undersea dominance requires an investment not just in boats and technology, but in people.

Our USW students receive degrees in a number of conventional fields — engineering, physics, mathematics and others — but their educational and research experiences are firmly rooted in the intricacies of undersea warfare. And these students come from all domains — surface warriors, aviators and the like, because dominance in the undersea domain is a team effort.

Relevance is a key trait of NPS, and demonstrating this is simply second nature to our institution. Whether it is in the development of critical programs for emergent officer communities, advanced research in critical defense fields, or providing the means to retain American superiority in a domain of warfare, the Naval Postgraduate School is always ready to demonstrate our worth.

CONTENTS

10 Advancing Materials Science on Campus
Materials research is intrinsically linked to Navy/DOD operations, and a recent collaborative effort between multiple departments on campus has rapidly advanced the university's education and research in this field.

12 Return to Dominance
What was once a powerful advantage for the United States began to lose prominence with the end of the Cold War. But domination in the underwater domain is back to the forefront, and NPS' 40 years in USW education is paying off now more than ever.

17 SIGS, CHDS Founder Returns for SGL
Dr. Paul Stockton left quite a mark during his 15 years on campus. Now Assistant Secretary of Defense for Homeland Defense and Americas' Security Affairs, he returned to campus to talk preparedness with students and faculty.

18 Evolving the Education of Civil Affairs
NPS faculty are pioneering the development of multiple educational programs dedicated to the complex operational requirements of the Civil Affairs community.

20 Applying Ethics to the Complexity of War
A new addition to the NPS Department of Defense Analysis, Dr. Bradley Strawser, is challenging students to understand the philosophical implications of just and moral warfare.

22 Evaluating Biofuels to Power the Fleet
A team of NPS students and faculty are evaluating biofuel blends to ensure the potential fuels will seamlessly transition to existing gas turbine and diesel engines.

4 University News

7 Faculty Showcase

21 Impacting the Future Navy
The Chief of Naval Operations Strategic Studies Group is an advanced generation team of NPS and Naval War College students with a unique opportunity to impact the future force through innovation and exploration.

24 Student Explores Privatization of Global Security
Navy Cmdr. Dan Straub, a Ph.D. candidate at NPS, examines the murky complexities of privatized global security in United Nations operations in his doctoral dissertation.

24 Math Faculty Develops Weather Prediction Model
Dr. Frank Giraldo and a team of researchers at NPS and beyond develop a candidate model for multi-agency weather prediction.

26 Summer Graduation

NAVAL POSTGRADUATE SCHOOL
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President
Daniel T. Oliver

Executive Vice President and Provost
Dr. Leonard A. Ferrari

Vice President, Information Resources and Chief Information Officer
Dr. Christine Haska

Executive Director, Institutional Planning and Communications
Dr. Fran Horvath

Director of Publications, Web Media "In Review" Managing Editor
Dale Kuska / dmkuska@nps.edu

Senior Graphics Designer
Gretchen Miller

Contributing Writers / Photographers
Joan Ackerman, MC1 (SW/AW) Grant Ammon, MC1 Leonardo Carrillo, Javier Chagoya, Rachel Davison, Senior Airman Grovert Fuentes-Contreras, MC1 Rob Rubio, Amanda D. Stein, Kenneth A. Stewart

On The Cover

The United States fleet of superior ballistic missile and fast attack submarines are without equal anywhere in the world, but dominance in the undersea domain cannot be taken for granted. For America to maintain, and fully realize, the vast advantage of strategic deterrence in USW, a cadre of officers must be educated to lead the return to dominance.

Naval Postgraduate School
1 University Circle
Monterey, CA 93943
(831) 656-1068 / pao@nps.edu

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Alumni Flag Officers Review Oceanography, Meteorology Programs

Rear Adm. Jonathan White, Oceanographer and Navigator of the Navy, and Director of Space and Maritime Domain Awareness

Rear Adm. Jonathan White, right

(OPNAV N2/N6E), and Rear Adm. Brian Brown, Commander, Naval Meteorology and Oceanography Command, visited the NPS campus, Sept. 23–26, for a curriculum review of the university's meteorology and oceanography programs.

During the visit, Brown and White, both NPS alumni themselves, reviewed student coursework and academic curricula, and held meetings with leadership and key faculty from the university's oceanography and meteorology departments. The two flag graduates also met with senior university leadership, participated in student thesis and dissertation presentations. According to Brown, the curriculum review serves to strengthen the education provided to NPS students, as well as improve readiness of the Navy.

White graduated from NPS with a master's degree in Meteorology and Oceanography and Brown earned a M.S. with distinction from NPS in Meteorology and Physical Oceanography.

Army's Cyber Commander Explores NPS Education, Research Programs

Lt. Gen. Rhett A. Hernandez, Commanding General of U.S. Army Cyber Command/U.S. 2nd Army, spent two days at NPS for an exploratory visit to the university, Oct. 1–2. The visit provided Hernandez and his staff an opportunity to build partnerships between his command and NPS.

"This visit provided an opportunity for our command to look hard at the educational capability of NPS, and how we can leverage the power of what the university is already doing from a cyber perspective," noted Hernandez. "I was very impressed with the passion and energy from the faculty and students here."

According Army Maj. Joshua Bundt, an NPS student who was handpicked to deliver a brief to Hernandez and his staff, the opportunity to provide an overview of his research to a senior military commander was an honor.

"I was selected by members of the Cyber Academic Group to deliver my thesis topic, and it was an absolute honor to present my research idea to the commander

Lt. Gen. Rhett A. Hernandez and NPS student Army Maj. Joshua Bundt

of Army Cyber Command," noted Bundt. "All the student presentations were well received by the general, who showed knowledgeable interest in each student's research question and emphasized the importance of the ongoing cyber related research at NPS."

Noting the operational relevance of the research conducted at NPS, Hernandez complimented students and faculty alike on their efforts in the cyber domain.

"The research I've seen presented here at NPS has been first class," noted Hernandez. "Most important is the operational relevance of all the subjects I've seen. It's things that military officers have learned over the last 11 years of war that they have been able to bring back to the educational system and examine."

NPS Interns Pay It Forward to Local Middle School Students

NPS summer interns recently served as mentors for Monterey County youth in a summer camp to help to grow interest in science, technology, engineering and mathematics (STEM).

The camp, "Cyber Adventurers — The Magic and Beauty of Computer Science," was a pilot program offered to 20 8th graders from Salinas, Calif. The interns, who facilitated the activities and mentored the younger students, were part of the Community College Catalyst Program, through which Hartnell College students work in NPS STEM research labs each summer.

"The Cyber Adventurers program is a result of two National Science Foundation grants for which Dr. Peter Denning has been the principal investigator," explained Sue Higgins, Deputy Director of the Cebrowski Institute at NPS. "Both grants address the national concern over a decade-long downward trend in the number of young people choosing to major in computer science in college.

"We designed Cyber Adventurers to provide a pipeline from middle school to college. Students experience the joy and beauty of computer science, learn how computer science relates to other disciplines in science, technology, engineering, arts and math," she added.

Student Intern Coordinator Cassie Martin will be a junior at California State University Monterey Bay in the fall, working towards her degree in computer science.

"What they are learning now, how to do binary and how pixels work, simple basic computer concepts, I learned my first and second year at Hartnell. And these kids are in the 8th grade," Martin explained. "I think it's a big advantage that they are getting all of this information at such a young age."

NPS Students, Faculty and Alumni Showcase University During Fleet Week

Navy Lt. Michael McCormick, an NPS mechanical engineering student, meets with members of the Golden Gate Junior Marines while working at an NPS outreach booth during San Francisco Fleet Week (SFFW) 2012. McCormick, along with students and faculty representing NPS' Consortium for Robotics and Unmanned Systems Education and Research (CRUSER), operated an NPS outreach booth to showcase ongoing NPS projects to members of the San Francisco community.

This year's festivities included the third annual Senior Leadership Seminar (SLS), which brought together leaders from the military along with local, regional, state and federal agencies and the private sector, to discuss their capabilities to respond to a natural disaster in the Bay Area. As part of the SLS' Cyber Security discussion panel, Dr. Cynthia Irvine, Chair of NPS' Cyber Academic Group, took on the role of moderator, leading a group of experts in the field on a discussion focused on the role data networks and applications play in supporting disaster response efforts.

NPS presence at 2012 Fleet Week in San Francisco

NPS Cebrowski Institute interns demonstrate robotics for a group of local middle school students.

Sub Group Commander Returns to Alma Mater to Talk Undersea Warfare

Commander, Submarine Group 2 (SUBGRU 2) returned to his alma mater, Aug. 1–3, to deliver remarks to Naval Postgraduate School Undersea Warfare students, and to strengthen the bond between the university and the operational submarine community.

Rear Adm. Rick Breckenridge, a 1989 graduate of NPS' electrical engineering and acoustic engineering programs, returned to NPS to tour research laboratories and facilities, meet with key NPS faculty, and deliver two lectures to undersea warfare students, as part of the university's Menneken Lecture series.

"For me, and in the undersea forces, we're looking at a lot of new capabilities from the undersea domain and NPS is doing a lot of work in those fields," noted Breckenridge during the visit. "If you're not improving, you're falling behind. We're a Navy that is committed to constant improvement, and you only get that through education."

Rear Adm. Rick Breckenridge, left, tours the autonomous systems lab.

While touring the university's autonomous systems laboratory, Breckenridge shared his experiences as a junior officer studying at the university, and reflected upon how graduate education improved his proficiencies as a submarine officer.

"I came to NPS after my junior officer tour on *USS Hammerhead*," said Breckenridge. "I was involved with the underwater acoustics program at the time, and it really helped me both with regard to our sonar systems, and our algorithms as well as our signal processing. I was able to employ them better as an operator because of my experience here."

As commander of SUBGRU 2, Breckenridge sees firsthand some of the technology he helped to develop and test while earning his master's degree at NPS being used in operational submarines.

"My thesis involved wave front curvature with regard to passive ranging," noted Breckenridge. "It's a technology we now use on our Virginia and Seawolf class submarines with our wide aperture arrays. It's great to see that this pioneering work has become one of the mainstay capabilities — from an acoustics perspective — on our submarines."

According to Lt. Scott Millhouse, an NPS student in mechanical engineering who attended Breckenridge's lecture on undersea warfare strategy in the 21st century, the opportunity to talk undersea warfare with an operational commander was a fulfilling experience.

"His talk was excellent. He was very well informed, and brought a lot of credibility to what he presented on," noted Millhouse. "His talks really brought together the big picture. He illustrated where the Navy is currently, and where the Navy is going. I was able to see the connection between my academic curriculum, and current and future naval applications."

NPS Students Develop Peace Gaming Model

NPS students recently presented a computer driven "peace gaming model" at the annual International Association of Peace Training Centers Conference in Helsinki, Finland.

German Army Capt. Danny Heerlein and U.S. Navy Lt. Cmdr. Matt Powers presented the Abyei Peace Gaming Model on behalf of their development team. The model is a tool that developers hope will improve the capabilities of civilian, military and non-profit agencies to respond to mass atrocities.

Dr. Jeffrey Appleget, bottom right, and his wargaming class at NPS

The model was built in response to a request from U.S. Navy Lt. Cmdr. Ryan Klaahsen of the U.S. Marine Corps' Combat Developments Command in Quantico, Va. Klaahsen approached NPS' operations research department looking for a "wargame" to explore Mass Atrocity Prevention and Response Options.

"Usually we focus on kinetic operations, army vs. army, but the work we are doing with NPS is helping us to plan for mass atrocities," said Klaahsen. "We are trying to teach our planners to successfully conduct conflict resolution

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Shuttle Endeavour Passes NPS During California Flyover

The Space Shuttle Endeavour, fixed atop a 747 jumbo jet, made its way across the Monterey Peninsula on Friday, Sept. 21, on route to the California Science Center in Los Angeles. There, the retired shuttle will be put on public display as one of five working crafts built for NASA's 30-year Space Shuttle Program.

The shuttle program ended in 2011, but not before Endeavour flew 25 missions and a total of 122,883,151 miles. The shuttle Endeavour flew her final mission, STS-134, in June of 2011, commanded by NPS alumnus Mark Kelly. That mission was the second-to-last for the shuttle program, which ended later that year with the success of STS-135 aboard the shuttle Atlantis commanded by NPS alumnus Chris Ferguson. The two commanders were among the 40 NASA astronauts to have attended NPS since 1959.

For more images of the shuttle flyover, check out the official NPS Facebook site at www.facebook.com/NPSmonterey.

continued from page 5

and peacekeeping operations."

Klaahsen hopes that the Abyei model will help planners to examine complicated regional problems through unfamiliar lenses. "It forces planners to become players and sparks conversation," he said.

The model was developed in Dr. Jeffrey Appleget's wargaming class, where students analyze the wargaming process, then develop models in response to his sponsor's planning needs.

"We are looking at the human element. We are not trying to predict behavior, but we are helping planners to see the possible impact of their decisions, and to begin to understand what second and third order effects might occur," said Appleget.

Heerlein wrote the code that makes the model work. It uses Sudan's Abyei region as a starting point. The region is divided into sub-regions into which planners can enter area specific information. Planners play the game in a series of rounds designed to test the affect of their decisions in response to regional actors and atmospherics.

As a German officer, Heerlein is excited about his work at NPS, and the potential impact it can have on his own service back home.

"This model demonstrates the value of sending international officers to NPS," said Heerlein. "We [German students] will be able to use the training we received here to affect real change in our operations … This model will go home with me and be used to train German officers."

Key Player in Maersk Alabama Hostage Rescue Addresses Students During SGL

NPS alumnus and former *USS Bainbridge* (DDG-96) commanding officer, Navy Capt. Frank Castellano, addressed NPS students, faculty and staff during a Secretary of the Navy Guest Lecture, Oct. 16 in King Auditorium. The *Bainbridge* caught the public's attention after it led the dramatic rescue operation that freed *Maersk Alabama* Capt. Richard Phillips from Somali pirates in 2009.

"This is a 'sea story,' my sea story," said Castellano in beginning his recount of the dramatic events. "My story is about teamwork … It's a human story about ordinary people doing extraordinary things," Castellano continued.

On April 8, 2009, Castellano was ordered to investigate a distress call several hundred miles off the coast of Somalia. His staff immediately began operations planning as intelligence came in and the *Bainbridge* closed in on the distressed vessel.

The *Bainbridge* arrived after a standoff between *Maersk Alabama* crewmembers and Somali pirates. While the pirates were ultimately repelled, they did manage to take *Maersk Alabama* captain Richard Phillips hostage and escape in one of the cargo ship's lifeboats.

FBI hostage negotiators, snipers, and *USS Bainbridge* Sailors worked together with Castellano to ensure Phillips' rescue. The lifeboat was repeatedly, "waked" [deliberately hit with the wake of the *Bainbridge*] to prevent it from getting too close to the Somali shore. And the *Bainbridge* was used to conceal a water landing

Navy Capt. Frank Castellano

zone for special operations teams who parachuted in under the cover of darkness. Snipers were able to target the pirates from the *Bainbridge's* fantail, killing three and ending Phillips' ordeal.

Castellano credits his NPS education with his ability to make the tough decisions and to endure the sleepless, high-stress environment that culminated in Phillips' rescue. "Intuitive decision making under stress was part of my thesis research at NPS … The innovative thought and critical thinking skills that I gained at NPS helped me to approach the problem in a non-traditional manner," said Castellano.

Regional Education Leaders Discuss Collaboration, Shared Vision

The presidents of several area colleges and universities joined 17th District Representative, Congressmen Sam Farr, and Naval Postgraduate School President Dan Oliver on the NPS campus for candid discussion on a wide range of topics, including the economics of higher education and opportunities for collaborative educational and research programs.

Congressmen Sam Farr, left, and NPS President Dan Oliver

"Dan Oliver and I served as co-chairs [of the Monterey County Business Council's Higher Education and Research Cluster], and are bringing together the various educational institutes to identify and collaborate on projects and economic activities," said Monterey Peninsula College President Dr. Doug Garrison.

The Monterey County Business Council (MCBC) is an alliance of executives, professionals and organizations that helps business, government, education and community leaders from myriad backgrounds work together on countywide issues.

Oliver and Garrrison's work with the MCBC reflects local recognition of the economic impact of higher education throughout the Monterey Peninsula. "Education is the second largest economic cluster in the 'Monterey crescent,'" said Garrison.

Congressman Farr recognized both the economic and intellectual contributions of the local institutions of higher learning.

"We have to measure the value of the intellectual capacity of the institute," said Farr. "NPS is receiving growing recognition from its graduates that are doing important things all around the world."

Economic impact was an important topic of discussion, but so too was collaboration. NPS is working with several local schools to collaborate on important research and to provide internship opportunities.

"A number of our students come to NPS to take classes, and our faculty collaborate … There is a lot of ways that we complement each other," said Monterey Institute of International Studies President Dr. Sunder Ramaswamy. "The faculty and students build the bridges, but as president, I hope for even more future collaboration."

NPS Professor Leads Efforts to Document Systems Engineering Body of Knowledge

Professor David H. Olwell of the NPS Department of Systems Engineering has played a lead role in developing the "Guide to the Systems Engineering Body of Knowledge (SEBoK)" released Sept. 14. Olwell is co-principal investigator and co-editor in chief of SEBoK, a compendium for systems engineering information and knowledge.

Professor David H. Olwell

Olwell led the charge at NPS, along with Professor Chuck Calvano and Associate Professor Ray

continued on page 8

NPS Distinguished Professor Awarded Prestigious OR Prize

Distinguished Professor Emeritus Donald Gaver

NPS Distinguished Professor Emeritus Donald Gaver has been awarded the 2012 Military Applications Society of the Institute for Operations Research and the Management Sciences (INFORMS) J. Steinhardt Prize. The award recognizes individuals for lifetime achievements in the field of operations research (OR), and was presented during the INFORMS Annual Meeting, Oct. 15 in Phoenix, Ariz.

The award is an exciting one for the NPS OR department as it marks the third time in a row, and the fourth time overall, that the university's faculty have been selected for the honor. Past recipients were longtime NPS Professor Wayne Hughes, and Distinguished Professors Dave Schrady and Al Washburn.

"Distinguished Professor Gaver is most deserving of this award," said OR Chairman and Professor Robert Dell. "He is a well-known name in operations research and has been so for more than four decades. He has made many substantive contributions to our nation's military capability and he is still actively contributing. We are extremely fortunate to have had him in our professional and scholarly ranks so long, and have benefited greatly from his substantive contributions."

Gaver first studied operations research as a master's student at the Massachusetts Institute of Technology, and went on to incorporate it in his mathematics studies at Princeton University, where he received his Ph.D.

"I am pleased and very grateful to have been selected for this award. The operations research field is a way of using mathematics and science to deal with operations, whether military or civilian," said Gaver. "Its practical uses can include helping to provide scientific guidance into the procurement and employment of weapons systems, or civilian systems like highways and such. I got into this field because it just seemed like an ideal combination of objectives."

The prize is named for Jacinto Steinhardt, a founding member of the Operations Research Society of America who worked extensively on the philosophy and application of military operations research. Gaver worked with Steinhardt during his time at the Operations Evaluation Group, which later became the Center for Naval Analyses.

"The award is particularly meaningful for the operations research department because Jay Steinhardt helped propose and design the operations research degree program at NPS in 1951, with the first class of nine naval officers graduating in 1953," Dell said. "We now have well over 4,300 graduates from all four U.S. military services, as well as those of 56 other countries."

continued from page 5

Madachy as authors, Ms. Stephanie Enck as an editor and several NPS faculty from the systems engineering and operations research departments as reviewers.

The major peer-reviewed, three-year effort is an important addition to the systems engineering literature, said Olwell. "This is a very significant project," he noted. "It strengthens our relationship with our partners and it emphasizes the Naval Postgraduate School's international role as a leader in systems engineering."

Former NPS Faculty Returns to Lecture in Joint FAO Course

Dr. Peter Lavoy, Principal Deputy Assistant Secretary of Defense for Asian and Pacific Security Affairs, delivered remarks to students of the Joint Foreign Area Officer (JFAO) Program's latest in-residence course focusing on FAO operations in the Asia-Pacific region, Aug. 22 on the NPS campus. Lavoy previously established and directed NPS' Center for Contemporary Conflict and taught in the university's Department of National Security Affairs.

"It's always a great opportunity to come back here to NPS," noted Lavoy. "The faculty and programs here have always distinguished themselves, and the opportunity to speak to Foreign Area Officers is important. We need more officers with area expertise, and I'm happy to do what I can to support the FAO program."

Dr. Peter Lavoy, Principal Deputy Assistant Secretary of Defense for Asian and Pacific Security Affairs

Lavoy shared his experiences working as Director of Analysis on the Director of National Intelligence staff, his thoughts on Asia Pacific stability and security, as well as his experiences working at NPS, with JFAO course participants. In his current position, Lavoy serves as the principal advisor to the Under Secretary of Defense for Policy, and the Secretary of Defense, on international security strategy and policy that relate to the nations and international organizations of Asia and the Pacific, their governments and defense establishments, and for oversight of security cooperation programs, including foreign military sales, in the region.

Ops Research Faculty Featured in Top Professional Journal

NPS Department of Operations Research (OR) Senior Lecturer retired Navy Capt. Jeff Kline was caught by surprise when he showed up on the cover of one of his field's top professional publications, the Institute for Operations Research and the Management Sciences journal, "OR/MS Today."

Retired Navy Capt. Jeff Kline

"When I submitted the article that explains teaching methods and programs here at NPS to the magazine's editor about a month ago, he didn't tell me it was going to be on the cover. So when the online version appeared and then the print arrived in our offices, there was quite a stir with my colleagues," said Kline.

Kline was the 2011 winner of the Teaching of Practice Award sponsored by INFORMS which led to his invitation to write the article on teaching methods in the OR arena.

CRUSER, NWDC Partner for Latest Warfare Innovation Workshop

U.S. Navy Capt. David Tyler, Assistant Chief of Staff for Concepts at the Navy Warfare Development Command (NWDC), opened the NPS Consortium for Robotics and Unmanned Systems Education and Research (CRUSER) Warfare Innovation Workshop, Sept. 17. The workshop focuses on undersea warfare innovation and includes participation from NPS faculty and students, as well as members from outside DOD agencies and other academic institutions.

The three-day workshop was launched in direct support of the NWDC's Line of Operations and is focused on the theme of Advancing the Design of Undersea Warfare. With the workshop scheduled during NPS' Summer Quarter Enrichment Week, organizers encouraged NPS undersea warfare student participation, including newly-selected Strategic Studies Group Director Fellows, as well as nominated participants from aligned DOD agencies, academia and industry.

U.S. Navy Capt. David Tyler, Assistant Chief of Staff for Concepts at the Navy Warfare Development Command.

As part of the workshop, attendees are asked to participate in an innovation seminar and then break into teams to develop responses to proposed scenarios involving undersea warfare operational concepts.

GSBPP Faculty Recognized Through Elite Academic Competitions

Assistant Professor Mike Dixon of NPS' Graduate School of Business and Public Policy (GSBPP) won an honorable mention at the Decision Sciences Institute's Elwood Buffa dissertation award for his recently published dissertation, "Sequence Effects in Evaluating, Scheduling, and Designing Service Bundles."

In addition, GSBPP Assistant Professor Chong Wang earned third place honors in the 5th International Public Procurement Conference's (IPPC) best paper contest for a work he co-authored with retired NPS professor Joe San Miguel titled, "The Excessive Profits of Defense Contractors: Evidence and Determinants."

According to Dr. Bill Gates, Dean of GSBPP, having junior faculty members participate, and enjoy recognition, in contests like these ultimately strengthens the academic experience offered to students at NPS.

"Recognition through contests such as these serve at least two purposes," noted Dr. Bill Gates, GSBPP Dean. "Academic recognitions are one metric indicating that we are in fact working at the forefront of our disciplines, ensuring we provide our students the highest-quality graduate education. They also increase the stature of GSBPP and NPS within our academic communities."

Defense Analysis Professor Selected for Inaugural Cyber Security Hall of Fame Class

NPS Department of Defense Analysis (DA) Distinguished Professor, Dr. Dorothy Denning, has been inducted into the National Cyber Security Hall of Fame's first class. The group of 11, honored during an official ceremony on Oct. 17, were nominated and selected based on criteria that, among other things, distinguish them as leaders and innovators within the cyber security community.

"Dorothy Denning's induction as one of the first members of the National Cyber Security Hall of Fame is an indication of the impact her body of work has had on the information security community over her decades in the field," said DA Chairman and Professor, Dr. John Arquilla. "Having her on the faculty is a great addition to the DA department, both increasing our academic diversity and enlivening our Joint Information Operations and Irregular Warfare curricula.

"Cyber security is a field of growing concern for the defense community, and cyberspace itself has, within the past year or so, been officially recognized as a warfighting domain," he added. "It's essential for our students to understand how to think critically about the challenges that come with this new strategic domain. Nobody supports this mission more effectively than Dorothy Denning."

Denning joined NPS in 2002, after teaching for 11 years each at Georgetown University and Purdue University. She also spent eight years working in industry. She first became engaged in information security as a Ph.D. student at Purdue in the early 70s.

"There wasn't a lot going on in this field back then. You could actually know everything that was going on, because there wasn't much," Denning recalled. "And there were just a handful of people working in the field, so you could know who they all were and read all of their papers. There weren't any conferences. There weren't any magazines or journals on the topic. The field has just skyrocketed since then."

Denning teaches two cyber courses in the DA department. The first, titled "Conflict and Cyberspace," covers the technology, policy, law and ethics of cyber conflict, addressing such topics as cyber warfare, cybercrime, hacktivism, cyber terrorism, and state control over cyberspace. The course was originally designed for DA students seeking a broad perspective on the field, but serves students in the cyber programs as well.

"Students in the DA department are coming to our programs for a broad education that's not so technology focused, looking at things on a broader strategic level," Denning noted. "So the course is aimed at getting at the issues and finding out what is going on at an international level.

Dr. Dorothy Denning, pictured third from right, gathers with the inaugural class of inductees into the Cyber Security Hall of Fame during the official induction ceremony, Oct. 17. Also pictured is Roger Schell, second from left, a former faculty member at NPS, and Army Genera Keith Alexander, head of the U.S. Cyber Command and a dual degree alumnus of NPS. (Photo courtesy of the National Cyber Secuirty Hall of Fame)

"I also teach a technical course called "Computer Network Attack and Defense," and that course is exclusively about technologies and methods that can be used for offensive and defensive operations," she added. "There is a little more focus on the defensive side. But you have to understand the offensive side also in order to understand the defensive side."

Also selected for the first hall of fame class was former NPS Associate Professor Roger R. Schell, who served three years in the late 70s as a military instructor in the university's computer science department. He and Denning entered the field relatively early on, and both have seen tremendous growth and value as the cyber domain becomes one of critical importance to the Department of Defense.

"The value of educating military leaders in computer security was evident even then," Schell said. "One of my students, Philip Myers, wrote a thesis entitled, "Subversion: the Neglected Aspect of Computer Security" that went on to be required reading for their senior staff when the government subsequently created the National Computer Security Center at NSA a few years later. The significance of cyber security has only increased since then, and well-informed military leaders are even more important today."

Denning, Schell and the nine other National Cyber Security Hall of Fame selectees were officially inducted during a ceremony in Baltimore, Md., on Oct. 17. The Hall of Fame was created to recognize key players from across the country for their contributions in cyber technology, policy, education, public awareness and business.

NPS Department of Mechanical and Aerospace Engineering (MAE) Associate Professor Claudia Luhrs, pictured in one of the Center for Materials Research laboratories, is one of a handful of new faculty hired through a collaborative effort between MAE and physics resulting in a dramatically advanced research and educational effort in the material sciences field.

NPS Injects New Life Into Advanced Materials Research

By Kenneth A. Stewart

SCIENTISTS IN LAB coats build tunnels through quantum space. They connect microscopic tubes and build structures that sense defects, carry information and deliver energy one molecule at a time. As fantastic as it may seem, researchers at the Naval Postgraduate School's newest academic center, the Center for Materials Research, have accomplished all of this and more.

The Navy has been thinking about materials research for a very long time. It is a discipline intrinsically linked to maritime history. Ships, and the sailors that travel upon them, rely upon materials research to survive the ravages of war, seawater and weather.

> *"We envisioned a center where we could bring together dynamic, new talent in the materials research field and partner them with seasoned researchers. The creation of this competitive new center demonstrates NPS' on-going commitment to defense-centered scientific research in a time when demand for innovative Navy materials solutions has never been greater."*
>
> Dr. Leonard A. Ferrari,
> Executive Vice President and Provost

NPS' Center for Materials Research (CMR) was born out of collaborative measures between faculty and administrators to meet the materials challenges of a modern naval force.

"We envisioned a center where we could bring together dynamic, new talent in the materials research field and partner them with seasoned researchers," said Dr. Leonard A. Ferrari, NPS Executive Vice President and Provost. "The creation of this competitive new center demonstrates NPS' on-going commitment to defense-centered scientific research in a time when demand for innovative Navy materials solutions has never been greater."

Distinguished Professor Emeritus Dr. Terry R. McNelley and Distinguished Professor Dr. Nancy Haegel spearheaded an effort to bring together top young scholars from across the academic spectrum to create the CMR.

"The need for sensors and new materials is very important to the fleet," said Haegel. "The Navy's needs drove our desire to hire new researchers from a variety of disciplines that could work across the varied fields that encompass materials research."

"The emergence of the center has enabled us to work across department boundaries and we have managed to strengthen materials activities here at NPS," said McNelley. "We no longer work in isolation, we have found ways to pull together … You could say that the sum of what we have done is much greater than its individual parts."

Those "individual parts" include a host of new faculty recruited to reinvigorate materials research at NPS.

"The reason that the CMR has coalesced in the manner that it has, is due to the new people that we have brought in. They have begun their own research which has led to new ideas and interests beings explored," said McNelley.

Increased coordination and new minds became necessary as the materials research field advanced at NPS. Modern materials research includes a mind-numbing host of academic specialties — metallurgy, corrosion analysis, nanomaterials, new materials, composites and physics to name a few.

"In the field today, there is a lot overlap between the disciplines," said Haegel. "Materials, physics, and engineering are now interconnected, especially now that we are working with materials at the nanolevel."

Distinguished Professor Dr. Young Kwon of mechanical and aerospace engineering, CMR director, works with the center on nanomaterial engineering. His work demonstrates the manner in which the materials sciences have evolved in recent years.

"Sometimes we are looking at materials as small as a few atoms," said Kwon. "Materials behave very differently at the nanolevel when compared to the same materials on the larger scale … We are synthesizing nanomaterials and looking for new applications."

Applications utilize what is seemingly the stuff of science fiction, nanotubes built at the molecular level, microscopic sensors and even nanonengineered engines. NPS researchers insist that none of these advances would have been possible without a cross-disciplinary approach to materials study.

And the approach has already begun to pay dividends. The application and study of composite materials has been combined with nanotubes research to repair cracks on ship structures and monitor the efficacy of composite patches.

"One of the many applications of composite materials is the use of composite patches on aluminum ships. Composite patching is less expensive and more effective than having to re-weld materials in drydocks," said Young. "Composite patches are more effective, but how do you know what is happening under your patch? You need to be able to monitor a crack once its been covered."

In order to see what's happening, Kwon and his colleagues have developed a method of using nanotubes beneath patches to monitor patched cracks. If the crack widens, the nanotube breaks, and the resulting loss of conductivity can be measured and used to monitor hull integrity beneath a composite patch.

But composite material researchers are not just patching ships. They are also working to create new materials for ships, materials that will allow engineers to build ships from lighter, stronger materials. These innovations promise safer, more fuel-efficient vessels for an increasingly, green fleet.

"We want to make fast ships … composite materials are light and corrosion resistant, they decrease payload and fuel consumption," said Kwon.

Another interesting application of nanotechnology at NPS involves the development and use of sensors built at the molecular level. Assistant Professor of physics, Dr. Joe Hooper of Altanta, Ga., specializes in 'shock physics.' Hooper is part of the 'new blood' recruited by the CMR. One of his projects involves the placement of microscopic sensors into the composite materials that compose the bodies of warheads. If successful, Hooper will be able to look inside a warhead as it detonates.

Assistant Professor of physics and mechanical and aerospace engineering, Dr. Sebastian Osswald, and his research group are utilizing nanostructures to enhance the performance of armoring materials, energy storage devices, and sensors. They are even developing "ion thrusters," miniature engines that may one-day power small spacecraft.

"We are developing a novel carbon nanotube field ionization engine that will, for the first time, allow for the design of scalable micro-ion thrusters, bringing us a step closer to the realization of nano and picosatellite technologies," said Osswald.

Dr. Claudia Luhrs is working to build lightweight metals that could potentially protect U.S. service members in the field from the shock forces generated by explosives and other weapons. She came to NPS after completing work at Intel and Toyota North America and holds five patents for innovative energy storage technologies.

Assistant Professor Dr. Dragoslav Grbovic is engineering microelectromechanical systems. These micro-sized machines, the width of a human hair, will harvest wasted energy for use in other applications. He is also developing micro-sized sensors and actuators for use in infrared and THZ imaging.

Oswald, Hooper and Associate Professor Dr. Luke Brewer are looking into the use of "nanodiamond" — the hardest material found in nature – to reinforce armor and harden structures.

Impressive as all of this may seem, it is only the tip of the iceberg. Work at the CMR has really just begun.

"We are already showing promise, we have good people, doing good research and we are receiving excellent sponsorship as we seek solutions to the Navy's most pressing material needs," said McNelley. IR

FROM TOP: Assistant Professor Dr. Dragoslav Grobvic calibrates a metal evaporator in one of NPS' Center for Materials Research laboratories.

In microscopic detail, nanotubes grown in NPS' Center for Materials Research lab are being used in the study of several diverse projects, from monitoring composite ship patches to the development of miniature satellite propellants.

RETURN TO DOMINANCE

What was once a powerful advantage for the United States began to lose prominence with the end of the Cold War.

But domination in the underwater domain is back to the forefront, and NPS' 40 years in USW education is paying off now more than ever.

BY DALE M. KUSKA

"Mr. Gorbachev, tear down this wall."

These iconic words, presented to rousing cheers by then President Ronald Reagan on June 12, 1987 in West Berlin, were the defining moment of a generation. With this single statement, the Cold War had visibly reached its end, the United States had won and the Soviet Union would disintegrate, changing the world forever.

Within the walls of the Pentagon, changes were abundant as well. The enemy was defeated, what was once a peer in the underwater domain would likely see its fleet of aging and expensive-to-operate submarines sitting at docks rather than patrolling the deep waters of the Atlantic and Pacific Oceans. With the victor come the spoils, and the United States' fleet of superior submarines, and the submariners operating them, went into cruise control.

Fast-forward a couple of decades, and the underwater domain has returned to its former prominence as an immensely critical battle space. Modern day superpowers have invested heavily in assets, both in vessels and weapons systems, clearly dictating their intentions for the deep sea. And Russia has refurbished a portion of that aforementioned aged fleet, and is now embarked on a program of building new classes of highly-capable subs. Just months ago, in fact, Russia claimed one its refurbished subs cruised the waters of the Gulf of Mexico — which has, of course, been since disputed.

The bottom line, undersea warfare is back, and has been for some time … One need look no further than the words of Chief of Naval Operations Adm. Jonathan Greenert, himself a submariner, for evidence of that.

"Undersea dominance is critical to the security of the nation. It is a warfare area assigned, uniquely, to Navy alone," he noted in a recent communication. "Our advantage in this domain, as a minimum, provides us assured access to deter and defeat, reassure allies and partners, and better understand the environment and our potential adversaries. This is the one domain in which the United States has clear maritime superiority — but this superiority will not go unchallenged."

Responding to those challenges, like every critical area of national security strategy, requires highly-competent, well-educated leaders. And the Naval Postgraduate School (NPS) has a dedicated educational program in Undersea Warfare (USW) positioned to produce them. The Undersea Warfare Academic Group, or USWAG, was created to develop and guide students through a rigorous curriculum of interdisciplinary coursework and research in the disciplines that impact USW, and they are studies clearly needed in the modern defense landscape.

"THE LESSONS THAT ARE LEARNED HERE AT THE NAVAL POSTGRADUATE SCHOOL PUT THE OFFICERS IN GREAT STEP FOR THE FUTURE…IT TEACHES THEM HOW TO THINK AND HOW TO APPROACH PROBLEMS AND IT'S GOING TO PROVIDE A PHENOMENAL RETURN ON INVESTMENT FOR THE NAVY AND FOR THE COUNTY BOTH."

REAR ADM. BARRY BRUNER
DIRECTOR OF UNDERSEA WARFARE

"We can look around the world and see that our significant threats are going to require anti-submarine warfare, mine warfare, etc. There are nations rapidly developing their submarine fleet, and their mine warfare capabilities, and it's very clear to Navy leadership that undersea warfare is critical," said Dr. Clyde Scandrett, Chair of the Undersea Warfare Academic Group.

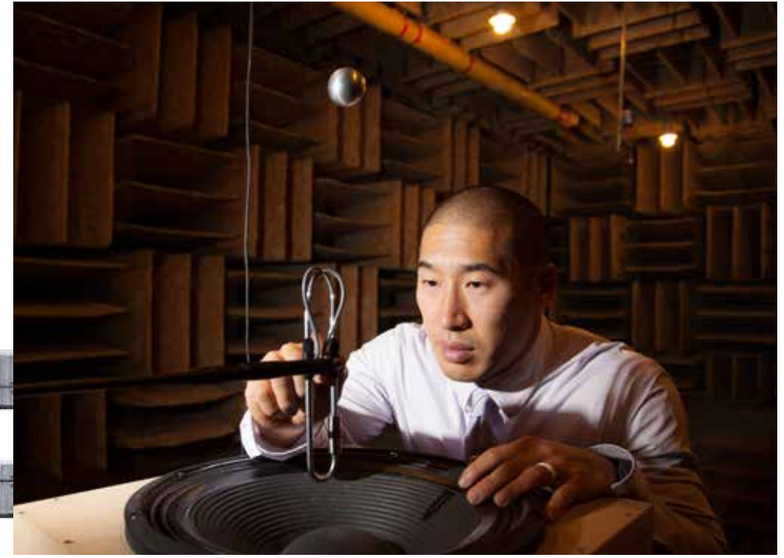
"There are about 400 submarines in the world and it's growing," added retired Rear Adm. Jerry Ellis, USW Chair and Director of the USW Research Center at NPS. "A lot of countries have chosen this to be the weapon of choice, because it has a tremendous disproportionate impact. A few hundred million dollar submarine can shoot a torpedo that takes out a multi-billion dollar warship," he added. Ellis spent 36 years on active duty, with tours on six separate subs including two as commanding officer, and he commanded the U.S. Pacific Fleet Submarine Force in his final sea tour.

Unlike most curricula on campus, USW students don't earn degrees in USW, rather they earn them in conventional programs like mechanical engineering, operations research, engineering acoustics, physics, electrical engineering, physical oceanography and math. And while that means they have to complete the requirements for that degree — on top of the USW technical curriculum and Joint Professional Military Education — the dividends returned to the students are striking.

"USW is a very unique program because it offers the student the ability to choose his or her field of study … This was advantageous for me because originally I chose electrical engineering as my curriculum, but after taking a few acoustic classes, I found engineering acoustics very interesting," notes Navy Lt. Steve Yang, a September 2012 graduate of the program.

"The knowledge gained here will undoubtedly assist me as a submarine officer in the undersea domain. Obtaining a master's, with undersea warfare, and specializing in engineering acoustics, will open up doors for me in the future that would be otherwise closed as I advance in my naval career," he continued.

The USWAG is a compelling example of how interdisciplinary, academically-rigorous programs can be utilized to fulfill unique DON/DOD educational needs. A committee of senior faculty at NPS from all relevant departments, along with several retired Navy flag officers and a close relationship with submarine warfare leadership in the Pentagon, guide an effort that results in graduate-level educational programs with a strong connection to current operational needs.



TOP Lt. Steve Yang, a 2012 graduate in engineering acoustics, and an undersea warfare student, completed a majority of his research in the physics department's anechoic chamber. Yang's studies into acoustic attraction lay the groundwork for advanced oil, water separation machinery.

BOTTOM One of the initial courses in the USW matrix is retired Rear Adm. Jerry Ellis' class on the four pillars of undersea warfare. Students from diverse curricula, and a number of officer communities, attend the course to develop an understanding of the many facets of dominance in the undersea domain.

One of the key players in designing the course matrix is Dr. Daphne Kapolka, a retired Navy engineering duty officer who completed her own doctoral studies at NPS in 1997. In her role as the Academic Associate for Undersea Warfare, Kapolka integrates a careful balance of coursework to the USW program.

"We are taking advantage of the expertise of several departments in a variety of very Navy relevant ways," said Kapolka. "Our students take courses in mathematics, physical oceanography, physics, electrical engineering, operations research and mechanical engineering … These core courses ensure that, when they go out the door, they possess a strong fundamental understanding of the principles of undersea warfare."

Not only does USW require an interdisciplinary academic approach, it requires an equally diverse group of players within the Navy

▸DOMINANCE CONT. ON PAGE 16

THE SILENT WARRIOR

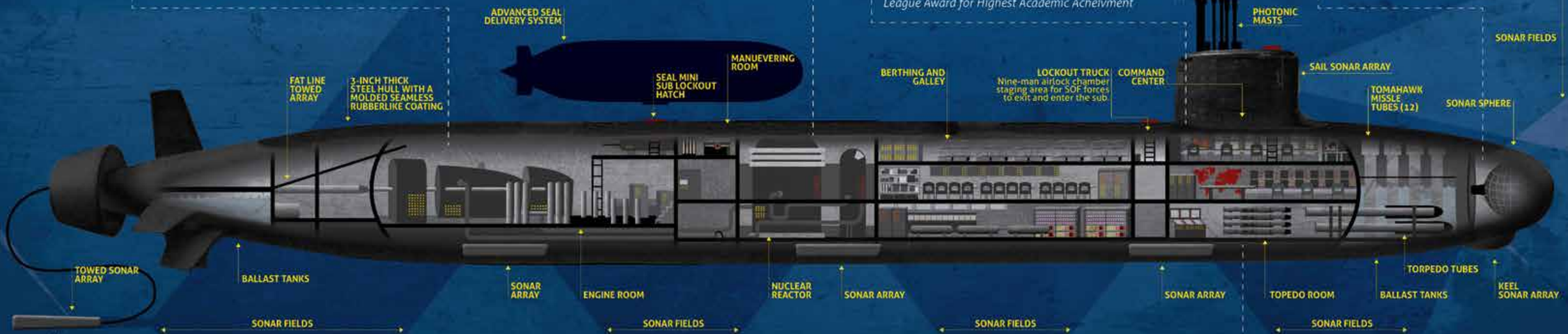
The U.S. Navy first developed submersibles more than 100 years ago, and today, the service owns and operates the world's most powerful fleet of nuclear-powered strategic deterrence. With the next generation class of submarine in development, and the Ohio class conversion program underway, the United States is positioned to maintain dominance in the undersea battle space for several decades to come. But that will not be without leadership and active discovery. At NPS, award-winning student thesis research impacts every inch of the modern Virginia class boat ... A few of them are highlighted here.

In-Situ Study of the Formation of Graphene and Nitrogen-Doped Graphene from Graphite Oxide/Urea Mixture
Lt. Mowry, Michael
Mechanical Engineering, Sept. 2012
Submarine Force Award for Excellence in Undersea Warfare; With Distinction

Thermophotovoltaic Energy Conversion in Submarine Nuclear Power Plants
Lt. John Howard
Electrical Engineering, Sept. 2011
Submarine Force Award for Excellence in Undersea Warfare

Tri-Level Optimization for Anti-Submarine Warfare Mission Planning
Lt. jg. Adam Thomas
Operations Research, Sept. 2008
CNO USW Award; CNO Award for Excellence in Operations Research; With Distinction; Outstanding Thesis; Monterey Council Navy League Award for Highest Academic Acheivment

Velocity Estimation Using Forward Looking Sonar
Lt. Michael Dolbec
Engineering Science (Mechanical Engineering), March 2007
NDIA/ASN (RD&A) Award for Excellence in Undersea Warfare Technology



Linear and Adaptive Plane Wave Beamforming with Towed Array of Acoustic Vector Sensors
Lt. Eric Jautaikis
Engineering Acoustics, June 2007
NPS Outstanding Thesis — The Submarine Force Award for Excellence in Undersea Warfare

Localization of Surface or Near-Surface Drifting Mines for Unmanned Systems in the Persian Gulf
Lt. Cmdr. Meng Wee Joses Yau
Republic of Singapore Navy
Physical Oceanography, June 2012
Outstanding Academic Achievement Award for International Students; With Distinction; NUWC Division Newport Award for Excellence in Undersea Warfare Technology

Expert System for Mine Burial Prediction
Lt. Christopher Beuligmann
Physical Oceanography, Sept. 2011
Surface Warfare Assoc. Award for Academic Excellence in Surface Warfare

Effect of Hydro-Reaction during Hypervelocity Impact and Penetration of Reactive Projectiles Against Submerged Targets
Lt. Abraham (Noel) Wadsworth
Applied Physics, June 2010
Submarine Force Award for Excellence in Undersea Warfare

SONAR FOR THE 21st CENTURY

Virginia-class submarines have vastly improved sonar capabilities and acoustic sensors. Using a combination of over 10 arrays in the bow, along the flanks and towed from behind, the Virginia-class sub will accurately map the ocean floor and mine fields in addition to providing quick target location information. The high sonic frequency active sonar mounted on the sail and keel is ideal for under-ice ranging and maneuvering and mine detection, while a medium sonic frequency active sonar helps target ranging and incoming object sensing.

UNDER THE ICE

As the melting of the arctic ice sheet opens up new land and sea for shipping lanes and natural resource extraction, countries with claims to the region are stepping up their military presence. Russia is planning to build a string of new naval bases in the Arctic Circle and Canada is planning a billion-dollar drone buy to protect it's arctic territories. The U.S. is increasing its Coast Guard and Naval exercises and patrols in the Arctic Circle as well. Submarines that can cruise below the ice sheets have long been used as patrol and protection of U.S. waters as well as those of our important allies.

▸DOMINANCE CONT. FROM PAGE 13

to execute. For this reason, officers from a number of communities attend the program.

Ellis defines four "pillars of undersea warfare" … Submarine warfare, anti-submarine warfare, mine warfare, and sub-sea warfare, a collective for unmanned systems, deep sea infrastructures and certain weapons systems. And all of them require air, surface and undersea to dominate.

"We have aviation officers, surface warriors, and of course, submarine officers, because USW is a team game," said Ellis. "Take anti-submarine warfare, for example, which requires ships, submarines, air assets — and officers that are educated to lead them.

"Anti-submarine warfare is probably one of the most important subjects we teach, and it is truly a joint effort. The days where we can use a single surface ship, or a single submarine or aircraft to find and track a submarine are long gone. We have to work together as a team, and when we do, it's pretty powerful," Ellis noted.

Lt. Ryan Hilger is a submariner in his first year of studies in the mechanical engineering curriculum. Hilger, however, is capitalizing on his time at the university by completing USWAG's anti-submarine warfare certificate program, and plans on completing a second certificate in national security studies as well.

"I believe, as a submariner, that spending the additional time to learn the theoretical foundations of my systems, procedures, tactics, etc., is crucial for my professional development and will help me better execute my role in the "Design for Undersea Warfare" and live up to the expectations set for me, and all submariners," Hilger said.

"I am doing here what the fleet wants me to do, and that is to use my education to think creatively and critically about real-world problems facing the fleet," he added. And he was just recently recognized for that critical thinking, honored with a Fleet Literary Award at the Naval Submarine League's Annual Symposium for his article, "Spurring Innovation at the Deckplate Level in the Submarine Force."

In addition to the interdisciplinary course matrix, research in USWAG is just as critical to the success of the program, and enables students to apply the intricacies of their chosen degrees to USW. Research topics are not in short supply … In fact, an overflowing binder of fleet-relevant topics awaits NPS students from all programs outside Ellis' office. "I'm adding to it all the time," he notes.

Thesis research in the applied sciences and engineering curricula is challenging and technical, and honors the graduate-level coursework students are required to complete.

For example, Yang's research into acoustic attraction examined the theoretically-predicted acoustic radiation force on a body that is small compared to the wavelength of the sound. Yang's work is not only excellent science, but may result in significant improvements for the fleet.

"Applications include the use of high-intensity ultrasound to separate unwanted particles from a liquid," Yang explained. "This research and experimentation lays down the groundwork for future oil, water separation machinery that could replace the antiquated machinery on ships today."

"ANTI-SUBMARINE WARFARE IS PROBABLY ONE OF THE MOST IMPORTANT SUBJECTS WE TEACH, AND IT IS TRULY A JOINT EFFORT. THE DAYS WHERE WE CAN USE A SINGLE SURFACE SHIP, OR A SINGLE SUBMARINE OR AIRCRAFT TO FIND AND TRACK A SUBMARINE ARE LONG GONE. WE HAVE TO WORK TOGETHER AS A TEAM, AND WHEN WE DO, IT'S PRETTY POWERFUL."

RETIRED REAR ADM. JERRY ELLIS
USW CHAIR AND DIRECTOR
USW RESEARCH CENTER

Another recent graduate, Lt. Michael Mowry, focused his mechanical engineering studies into a different area, but one that he says is a critical issue across the Navy and beyond.

"When I was looking for a research topic, I sought after a topic dealing with the energy storage problem, as I feel that energy storage and energy generation is arguably the most important challenge facing the Navy, military, and nation as a whole," Mowry noted. "It was very exciting to work on this topic during my time at NPS and I'm proud of the research that we accomplished."

Mowry focused his efforts on studying the formation of nitrogen-doped graphene at an industrial level. "Graphene is a relatively newly-studied material that has such a high potential all through electronics," Mowry noted. "But my research was focused on graphene production more suited for energy storage … as a bulk commercial production method for use in energy storage applications."

And in spite of the drastic differences between Mowry's research and that of Yang, he echoes much of the same sentiments as his peers in the program.

"The USW program does add a lot of extra course work, in addition to the degree requirements, but I feel as though it is time well spent," Mowry said. "The additional classes required by the program exposed me to different areas of study than I would have received from just the mechanical engineering requirements, which helped me understand more advanced concepts in physics and acoustics than I would have otherwise. This better understanding in several different disciplines, I believe, will help make me a better submariner and Naval officer, and although I was quite challenged at times I was never overwhelmed."

The final piece to the USW puzzle is a close relationship with the USW leadership. Recent campus visits by Rear Adm. Rick Breckenridge, Sub Group Two Commander and an NPS alumnus, as well as Vice Adm. John Richardson, Commander, Submarine Forces, provides a direct link between the students' work and operational leadership.

But it's the connection between USW leaders in the Pentagon that drive the program. A constant flow of communication between Ellis, Mine Warfare Chair retired Rear Adm. Rick Williams, and USWAG faculty with leadership in the Navy's Undersea Warfare Division infuses the education with the needs of the forces.

Director of Undersea Warfare for the CNO (OPNAV N97), currently Rear Adm. Barry Bruner, travels to the university annually for a detailed review of the curriculum, its research, and its students. Bruner is himself an NPS graduate, and expressed his own thoughts on not only the program, but on the larger value of an education at NPS.

"The two years that I spent here were two of the best years of my life, and it's great to see how this great institution continues to get better," Bruner noted. "The lessons that are learned here at the Naval Postgraduate School put the officers in great step for the future … It teaches them how to think and how to approach problems and it's going to provide a phenomenal return on investment for the Navy and for the country both." IR

Dr. Paul N. Stockton addresses NPS students, faculty and staff during a Secretary of the Navy Guest Lecture, Sept. 25. Stockton left a significant mark on the university during his 15-plus years on campus, founding both the School of International Graduate Studies, and the Center for Homeland Defense and Security.

SIGS, CHDS Founder Paul Stockton Returns to NPS for Briefings, SGL

By Amanda D. Stein

A FAMILIAR FACE returned to campus, Sept. 25, as NPS welcomed Assistant Secretary of Defense for Homeland Defense and Americas' Security Affairs Dr. Paul Stockton for a campus visit, meetings with faculty and students, and a special Secretary of the Navy Guest Lecture (SGL).

Stockton is familiar with NPS, joining the institution's faculty in 1990 in the national security affairs department. Stockton would later serve as founder and acting dean of the School of International Graduate Studies (SIGS), and established the Center for Homeland Defense and Security (CHDS) in 2002.

"I've had a chance to talk with many students and faculty over the last couple of days," Stockton said. "It's so impressive how NPS is staying at the cutting edge of emerging security challenges for the United States, both in terms of having the curricula that the nation needs for its future leaders and the kind of research that you absolutely have to conduct in order to know what to teach these students.

"The thing that impresses me most after having been away for many years is not the NPS that used to exist, but the NPS that exists today," he added. "Being on the leading edge of emerging security challenges where the nation most needs us."

The idea of readiness was at the heart of his message to NPS students and faculty as he delivered the SGL. He hoped to convey the importance of being prepared, not only for the kinds of natural disasters that our country has faced before, but also to be prepared for the unknown.

"We need to start rethinking the severity of the catastrophes for which the nation needs to be prepared," Stockton said. "We are, I think, much more prepared now for a Hurricane Katrina-scale event, but it could be worse. We could face much greater challenges.

"It's going to require thinking by the military, and collaborative partnerships above and beyond what we have ever had in the past. There are hazards to the security of the electric power grid, for example," he continued. "If the grid goes down, due to an earthquake, other natural disaster, or a cyber attack on the United States, we need to do a lot to build resilience for such events before they occur. And then if they occur, when they occur, be in a much better position to save lives."

Stockton explained that one of his primary goals since being confirmed for his current position in 2009 is to ensure resilience, meaning that even in the event of a natural or manmade catastrophe that disables critical infrastructure, the missions of the department can still be executed.

"At the end of the day, that's my focus. It's part of my responsibility for homeland defense to ensure that no matter what, the Department of Defense can execute the missions that the president assigns to it, even if, for example, the electric grid goes down."

Amid campus meetings and department briefings, Stockton was particularly pleased with the work being done in the university's defense analysis and homeland security programs.

"[The Naval Postgraduate School] has a national treasure, here in the defense analysis curriculum, that supports the special operations and low intensity conflict community," Stockton said. "It's absolutely first rate what is being done here, both in research and education.

"Also, especially important to me, is the homeland security curriculum here, sponsored by FEMA and the Department of Homeland Security," he added. "It has students from across the nation as well as many state and local students from fire, police and other professions that are going to be on the cutting edge of saving lives. That program is thriving. It's an example of how the faculty here make it possible to meet emerging security challenges. That's what makes NPS a national treasure." IR

Seated next to Provincial Reconstruction Team (PRT) Khost, Afghanistan's Commanding Officer, U.S. Navy Cmdr. John Wade, center, and Civil Affairs Team Lead U.S. Army Capt. Al Tofani, center-right, is the newly-appointed Spera District Sub-Governor Muhammad Kamin, at the his first Shura with tribal elders and influential Islamic clergy members. Shura means "consultation" and is the method by which Afghan tribes select leaders and make major decisions. The complexity of reconstruction and development post-conflict is just one of the missions faced by modern civil affairs officers. Developing educational programs at NPS provide a foundation of socio-political and cultural concepts that will help this community execute their diverse operational requirements.

NPS Evolves Security, Stability and Development Studies for the Civil Affairs Community

By Kenneth A. Stewart

THE NAVAL POSTGRADUATE SCHOOL has embarked upon an ambitious graduate program designed to educate members of the military's civil affairs community.

The Stability, Security and Development in Complex Operations (SSDCO) is a graduate certificate program born from the realization that civil affairs studies are central to the prevention of conflicts.

"We are starting to understand that the civil affairs community is central to our strategies abroad," said program founder, Assistant Professor Dr. Karen Guttieri. "It is important to think beyond war … After the experience in Afghanistan and Iraq, and the Balkans before that, we've learned the hard way how to manage civil-military operations. We need to capture the lessons of that experience and build institutional knowledge for the future."

The security and development program is designed to expose civil affairs, psychological operations and legal specialists to advanced legal, socio-political and behavioral concepts.

"Our military professionals work in complex environments with diverse civilian actors, including governmental and non-governmental agencies … Soldiers must understand the dynamics of the human domain, what measures are effective to prevent conflict and to respond when disaster strikes," said Guttieri.

The SSDCO program prepares its students for these complex environments by combining 'boots-on-the ground' experience with advanced graduate studies — which the group hopes will eventually lead to a modular master's in public policy with a focus on civil affairs and psychological operations.

"Some of our students complain that they are being placed in civil affairs roles that they were not trained to accomplish. If we can start to fill that educational gap, we can have real impact on the way the military conducts civil affairs operations," said Graduate School of Business and Public Policy Dean Dr. Bill Gates.

SSDCO classes are interactive with students researching hot-button socio-political topics. On any given day, students debate everything from the affect of social network sites on the Arab Spring to human rights law and just conflict theory.

Guttieri utilized a multidisciplinary approach when developing the program. Her students focus on three core areas — security and stability operations, rule of law, and human behavioral dynamics. Certificates are offered in a modular format that combines in-house instruction with distance learning culminating in a graduate research project.

Guttieri and Gates both cite the military's increased emphasis on stability and peace operations, and conflict prevention, as the impetus for expanded civil affairs education at NPS … a vision that is stated quite clearly in the services' guiding strategies.

"Our commitment to protecting the homeland and winning our Nation's wars is matched by a corresponding commitment to preventing war … preventing wars is as important as winning wars," notes the U.S. sea services' "A Cooperative Strategy for 21st Century Seapower," released in 2007.

The evolution of this statement has led senior leaders in the civil affairs and psychological operations fields to recognize the need for advanced education in this critical area.

> *"This gives us a global perspective and exposes us to information that we would not normally receive. This program is taking us from the tactical to the strategic level, and will give us the confidence to stand before operational commanders and offer courses of action."*
>
> Lt. Col. Bill Kelly
> Civil Affairs, U.S. Army Reserves

"We can no longer rely upon specialists, we must have pentathletes that are capable of solving problems across disciplines," said Psychological Operations Branch Chief, U.S. Army Col. Michael A. Ceroli of McDonald, Ohio.

Current students insist that they have the real-world experience, and they have benefited from veterans in the field. But for many of them, this is their first exposure to graduate-level civil affairs studies.

"Past training was very linear, this [program] gives us a global perspective and exposes us to information that we would not normally receive," said U.S. Army Reserves Lt. Col. Bill Kelly of Chicago, Ill. "This program is taking us from the tactical to the strategic level, and will give us the confidence to stand before operational commanders and offer courses of action."

According to U.S Army Capt. Steven Barnard of Warrignton, Ore., past civil affairs education programs were limited by both time and funds.

"Reserve officers were given several weeks of instruction and a box of books," said Barnard. "The majority of the Army's civil affairs community is composed of soldiers serving in the U.S. Army Reserve without access to graduate-level education in this area."

Reservists were at a disadvantage due to their needs to juggle civilian careers and military education. The modular nature of Guttieri's program seeks to overcome this disadvantage while offering world-class graduate instruction. Classes are delivered in both traditional and non-traditional formats including distance learning, teleconferencing and hybrid coursed that combine both in-house and off-site instruction.

Guttieri and her colleagues hope that by making graduate level civil affairs education accessible, students will be able to get out of the 'training mindset' and adopt a more mature, academic approach to complex civil affairs related problems.

"Traditional training programs are designed to develop problem solving skills within existing well-defined systems of knowledge," said Guttieri. "This type of training is useful, but researchers must move beyond traditional training paradigms if they are to have a significant impact in troubled regions."

U.S. Army Reserves Lt. Col. Michelle Haberlach believes that advanced civil-operations-focused education will benefit commands working in complex environments, particularly those environments where the actions of a few bad actors have had strategic-level consequences.

"If we as leaders are not educated, how we can show our commanders how the actions of their service members can have strategic-level impact on the ground," said Haberlach. "This kind of education can have a lasting impact on our ability to actually conduct stability operations more effectively and efficiently."

U.S. Army Reserves Maj. Staus Scantlin shares Haberlach's assessment and calls upon historical evidence to support the need for advanced civil affairs education.

"We got through WWII in Europe in good shape, because the Germans treated us like we treated them in WWI," said Scantlin. "I believe in the military as a profession of arms, we are professionals … We have to understand that war is a reality and that we are going to mitigate the effects of war through our conduct."

Haberlach and Scantlin believe that advanced studies in governance, rule of law and stability operations are the keys to success in areas like Iraq and Afghanistan. They are passionate about the education they are receiving and the troubled regions they assist.

"There are places in the world that do not share the liberties and comforts that we have here," said Haberlach. "We are able to go to those places and help them to enjoy the liberties that we share." IR

Stanford University's Peace Innovation Lab Project Director Margarita Quihuis speaks to NPS students completing graduate studies at the Graduate School of Business and Public Policy's Stability and Development in Complex Operations program. Students discuss the role of social media in transitioning societies and the effect of the Internet on stability and development operations.

New NPS Professor Applies Philosophy, Ethics to the Complexities of War

By Amanda D. Stein

THE NAVAL POSTGRADUATE SCHOOL Department of Defense Analysis (DA) welcomed a new face to the department — an ethicist and philosopher whose fresh perspective has students talking about the ethical implications of warfare.

Assistant Professor Dr. Bradley Strawser helps students think critically about the important ethical questions surrounding war. Strawser, a former member of the Air Force, served as a professor at the Air Force Academy and the University of Connecticut before finding his way to the Naval Academy's Stockdale Center as a postdoctoral research fellow.

And now since joining NPS, Strawser has begun teaching classes in critical thinking and ethical decision making, where students explore ethical challenges in an applied way, drawing from case studies and real-world examples to get to the bottom of tough questions.

"I view my job as to push them, challenge them, and get them to wrestle over these deep questions. I hate war — war is a horrible thing. But I do think in some contexts war can be morally justified," Strawser explained. "And wrestling through that is a complicated, difficult task. I think my main role is trying to push the students to engage in that process of taking the moral questions of what they do for a living seriously."

Strawser's classes seek to empower students in their ethical decision making by giving them the tools and resources to explore a number of scenarios — such as the use of unmanned systems to deploy lethal force, or the facets of irregular warfare.

> *"It's crucial for our students to have an opportunity to explore the ethical implications of their decisions, especially as they practice their profession in an era of protracted warfare against shadowy opponents. Professor Strawser will challenge our students — Americans and internationals — to look at a range of issues objectively and carefully from an ethical perspective."*
>
> Dr. John Arquilla
> Professor and Chair, Defense Analysis

"We are very pleased that Bradley Strawser chose to join NPS," said DA Chairman and Professor, Dr. John Arquilla. "As a philosopher, he adds to the diversity of the DA department faculty. As someone interested in the ethics of going to war justly, and waging war in a moral manner, his expertise is much needed.

"It's crucial for our students to have an opportunity to explore the ethical implications of their decisions, especially as they practice their profession in an era of protracted warfare against shadowy opponents," he added. "Professor Strawser will challenge our students — Americans and internationals — to look at a range of issues objectively and carefully from an ethical perspective."

Given Strawser's previous experience at the Air Force and Naval academies, and now at NPS, he has been impressed with the caliber of men and women who will ultimately be the defense department's decision makers of the future. He noted that his students take the ethical conversations seriously, and understand their roles as military leaders in ensuring the best choices are made in the battlefield.

"I think most people will agree that we need to think morally about war. What is controversial is when you actually come to some clear conclusions on things. When you say, 'I wrestled through that and I think this is probably morally wrong.'

With the addition of Strawser, the DA department hopes to offer additional classes in the future, further drawing on his expertise to enhance the breadth of the DA curriculum.

"There is a big resurgence in the literature on the ethics of war right now, so it's a great time for me, professionally," Strawser said. "In any given discipline, topics ebb and flow in their popularity, and right now in philosophy, this is the hot thing. It's a really exciting time to be a part of it as a researcher, but it's also a really satisfying thing to teach to the actual practitioners of war.

"The hope is that we can teach to that ongoing dialog rather than shy away from it. Get the students themselves involved in the debate," he added. **IR**

NPS Assistant Professor Bradley Strawser recently joined the defense analysis department, bringing with him a background in philosophy and ethics that will challenge students to explore the ethical implications of war.

Chief of Naval Operations Strategic Studies Group (CNO SSG) Director retired Adm. James Hogg, center, addresses the NPS contingent of Director Fellows for CNO SSG XXXII on the day of their final selection for the fellowship.

NPS Students Impact Future Navy Through Strategic Studies Group

By Rachel Davison

EACH YEAR, SELECT students from the Naval Postgraduate School travel to the U. S. Naval War College in Newport, R.I., to become Chief of Naval Operations Strategic Studies Group (CNO SSG) Director Fellows.

Established in 1981, the CNO SSG is a concept generation team, tasked by and accountable to the Chief of Naval Operations, to explore and innovate revolutionary naval warfighting concepts at the operational level of war. Each year, the CNO gives the SSG a new research theme and tasks them to prepare one final report that summarizes the year's findings and recommendations. Past SSG work includes conceptualizing ForceNet, developing synthetic fuels, and integrating the rail gun into naval tactics. NPS students have been involved in the effort since 1995 with SSG XV.

The CNO SSG is comprised of three diverse groups of fellows that represent technologists, operators and analysts. The six Technology Fellows are mostly non-military researchers with experience in applied science and engineering. The 10 CNO Fellows are senior officers with about 20 years of service. And finally, the 14 Director Fellows are mid-grade officers with about 10 years of service. Director Fellows matriculate with roughly equal numbers from the Naval War College and NPS, with selection overseen by CNO SSG Director retired Adm. James Hogg.

"Adm. Hogg believes some of the most innovative ideas come from mid-grade officers because they have recent operational experiences and have benefitted from the exceptional educational opportunities at NPS and NWC," said Marine Corps Maj. David Coté, who recently completed participation with the SSG XXXI Director Fellows.

"As a newly-designated member of the SSG, I will be working with my colleagues, experienced and distinguished senior officers, and handpicked scientific experts in order to develop revolutionary new concepts to shape future naval strategy. That is not just a byline, it is our mission and that excites me because it will have a measurable impact on how we fight in the future," said Navy Lt. Edward Tremblay, a space systems engineering student in NPS' Graduate School of Engineering and Applied Sciences who is participating with the current SSG XXXII.

Coté says his experiences and studies as a student at NPS were immediately applicable to participation in SSG XXXI. He noted, "As an NPS operations research student, I am surrounded by critical thinkers from every service and warfare designation. When I joined the SSG, I felt equipped with a unique skillset to help our team think critically about how to integrate a systematic approach to generate, ideate and assess warfighting concepts that focused on some of our most intractable and revolutionary warfighting problems."

All of the branches of service and warfare communities have been represented in the SSG, supporting the idea that a diverse team benefits the process of innovation.

"This past year, our SSG team focused on protecting the electromagnetic environment as a primary warfighting arena, and reducing the U.S. Navy's reliance on the electromagnetic spectrum," Coté said. "Too often, our security failures have been the result of a lack of imagination – about the enemy, our friends, and our own military."

As a part of the governance and policy concept team, Coté's SSG research led him to visit Harvard Law School, Massachusetts Institute of Technology, Microsoft and Qualcomm to name a few.

"As an SSG Fellow, I was able to apply my expertise in applied mathematics to my desire to redefine the way the Navy fights … The CNO SSG was a tremendous experience. I think my refined ability to prioritize, analyze and optimize will most certainly benefit my remaining work at NPS, but I am also confident that it will help me with future decision-making challenges as an officer, analyst and leader, especially in a resource-constrained environment." **IR**

Naval Postgraduate School students Coast Guard Lt. j.g. Adam Paz and National Oceanic and Atmospheric Administration Lt. j.g. John Petersen hold beakers of blended fuels that will be tested in various engines. The two students are collecting fuel efficiency data to determine the best blend for various biofuels that can run in conventional and modified diesel and jet engines.

NPS Researchers Evaluate Biofuels for Powering the Fleet

By Amanda D. Stein

AS THE LARGEST consumer of fuel in the United States, the Department of Defense has recognized the need to reduce its own dependence on foreign oil, and explore cheaper, safer alternatives. In support of those efforts, Secretary of the Navy Ray Mabus announced in 2009 a number of energy initiatives for the Navy, culminating in, among other things, a 50 percent reduction in petroleum-based fuel consumption in the fleet by 2020.

A team of researchers at the Naval Postgraduate School, in collaboration with various other research institutions — including the Office of Naval Research, the U.S. Naval Academy and the University of Wisconsin — are applying their experience in combustion to help the Navy meet Mabus' goals.

NPS Department of Mechanical and Aerospace Engineering (MAE) Associate Professor Dr. Christopher Brophy, and MAE Professor and Chairman Dr. Knox Millsaps, are working to help the Navy understand how alternative fuels will perform in existing gas turbine and diesel engines. The goal is to seamlessly transition to the biofuel blends without having to change any of the engines' components.

"The Naval Postgraduate School's part in this is really helping with certification, to give the Navy confidence through fundamental measurements that the fuels look, smell and taste the same, so to speak," Millsaps explained. "These fuels should have the form, fit and function to serve as direct drop-in replacements. They don't want to modify any of the systems to accommodate these fuels.

"Our research focuses on the fundamental combustion and engine-use part of the fuels, and not the production of them. Once it's in an engine, does it physically spray the same as a regular fuel? Does it burn the same? Does it have the same emissions characteristics? We have seen that biofuels actually tend to burn cleaner," he added.

The NPS team is testing the combustion of the alternatives to the Navy's current JP-5 and F-76 fuels — algae-based, hydro-reformed diesel (HRD), and camelina-based, hydro-reformed jet (HRJ) fuel blends. The 50/50 blends would incorporate half of the petroleum-based fuels currently being used, and half of either the algae or camelina fuels. The blending of the fuels will make the transition easier on the engines, and help the Navy reduce the amount of petroleum-based fuels needed to run the fleet.

"We know you can't go 100 percent biofuel because, in aviation or ground-based systems, existing seals rely on particular ingredients found in conventional petroleum fuels which causes them to swell and provide proper sealing," explained Brophy. "If you put them in biofuel, they tend to swell only a fraction of what is expected.

"The question was how much biofuel can the engines handle," he explained. "We don't really know the demarcation line between what fraction of biofuel you can run, but 50/50 is what the Navy has selected to date because we know it works."

One of the challenges with biofuels is that the scarcity of the product makes it more expensive than the fuels the Navy currently uses. To harvest algae and camelina, a member of the mustard family, in quantities large enough to fuel the fleet is a challenge, and one that has driven up the cost of production for the biofuels. For the three-day Great Green Fleet Exercise that took place during the 23rd Rim of the Pacific Exercise in July, the Navy purchased 450,000 gallons of biofuel to run the blend in two destroyers and several dozen planes for two to three days.

The cost per barrel of the biofuels led to questions on the Great Green Fleet exercise at a time when the defense department's expenses are being scrutinized. Mabus addressed them in the Navy's "Currents" magazine, explaining the importance of finding alternatives to fossil fuels.

"Throughout the Navy's history, we have pioneered the way we fueled the fleet. In the 1850s, we moved from sail to coal. In the early 20th Century, we left coal to transition to oil and we led the way to nuclear power in the 1950s," Mabus wrote. "At the time of each energy transformation, there were doubters and naysayers who said trading a known source of energy for an unknown one was too risky and too costly. But the Navy pursued innovation because it improved the capability of the fleet and made us better warfighters."

Mabus visited the Naval Postgraduate School in 2011 to tour the biofuels lab, and learned about the university's new energy degree program and ways that students are helping address the energy challenges facing the Navy.

Since NPS has become involved in biofuels research, the team has had three recent mechanical engineering graduates explore the topic in their theses research, and three more are currently involved — Navy Ens. Warren Fischer, Coast Guard Lt. j.g. Adam Paz, and National Oceanic and Atmospheric Administration (NOAA) Corps Lt. j.g. John Petersen.

"This research will not only greatly benefit the Navy but our entire nation," Petersen explained. "Supplementing our use of conventional fossil fuels with renewable fuels will significantly increase our energy independence and energy security. In addition to the tactical benefits, there are many environmental benefits that renewable fuels have over the use of fossil fuels. As an NOAA Corps officer, I am proud to be working on a project that will have a positive impact, not only on the Navy, but on our nation and the global environment overall." **IR**

In a mechanical engineering laboratory on the first floor of Watkins Hall, biofuels are run through a conventional engine for evaluation as direct drop-in replacements to conventional fuels.

Researchers Apply the Latest Battery Chemistries to Power the Fleet

By Kenneth A. Stewart

Students and faculty at the Naval Postgraduate School are planning to design and build a battery using technologies that have already been called a potential game-changer.

Doctoral student U.S. Army Capt. Andrew "Drew" Johannes, along with thesis advisors Assistant Professor Sebastian Osswald of the NPS mechanical and aerospace engineering, and physics departments, and Visiting Professor Joseph Farmer of Lawrence Livermore National Laboratory, have begun working on a Semi-Solid Flow Cell (SSFC) battery, which they believe has the potential to radically change the way the military powers everything from forward operating bases in Afghanistan to warships at sea.

"I am an Army combat engineer by trade. I was building FOBs [Forward Operating Bases] in Afghanistan in 2004 and 2005," said Johannes. "The Army runs on generators, they are loud and they often run all night. What if you could have an energy storage mechanism where you could run generators during the day, but turn them off at night and still have power?"

The SSFC battery system in development could make this clear advantage for FOBs a reality, allowing the bases to maintain a more tactical posture at night. Its implications to Navy ships are just as advantageous, allowing for efficient energy storage that can be used when needed to power critical ship systems.

What makes SSFC batteries work is a substance cleverly dubbed, "Cambridge Crude," because of its development by researchers at the Massachusetts Institute of Technology (MIT). Initially created utilizing lithium-based chemistry, the NPS team sought to utilize a similar concept, but based it on traditional, low-cost battery chemistries found in the majority of batteries used today.

"We are using a different chemistry than the Cambridge guys, which requires different hardware and a modified design. They were really shooting for the moon, we are essentially dumbing things down to create a simpler application," said Johannes.

Whether based on lithium, lead or nickel, the crude is an electro-active material, part liquid and part solid, consisting of small pieces of battery anodes and cathodes suspended in an electrolyte solution. When this slurry of positive and negatively charged materials flows over an electrode, electricity can be stored or created.

And beyond a new method of energy storage, SSFC technologies are also much more efficient as well, especially when the batteries are not in use. And while efficient energy on the battlefield is one of DOD's most pressing issues, the implications of this research go far beyond traditional military operations to power storage grids, and much more.

Student Dissertation Explores Privatization of Global Security

By Amanda D. Stein

IT MAY NOT be immediately obvious how a focus in environmental resource policy could lead one to ask the tough questions about the privatization of global security, but for Naval Postgraduate School national security affairs (NSA) doctoral student Cmdr. Dan Straub, the privatization of any number of things — from water to security — brings with it potentially critical implications.

"The privatization issue is really important to me," said Straub. "I started out looking at water scarcity. And what I saw was that real conflicts were occurring around the privatization of scarce resources."

After consulting with professors in the NSA department, Straub began to see a bigger picture of privatization issues emerging. In his dissertation, he explores the idea of using private global security companies in peacekeeping efforts, and what kinds of complications arise when doing so.

"This dissertation deals with an extremely important topic … As Cmdr. Straub demonstrates, private security contractors, or PSCs, have been used for all imaginable security roles and missions but for one — peacekeeping under United Nations auspices," explained Distinguished Professor Thomas Bruneau, Straub's thesis advisor. "He analyzes the positive and negative dimensions of this possible outsourcing, and provides a tremendous amount of new data. The dissertation is based on both a thorough analysis of all available documents as well as extensive interviews with informed experts and practitioners."

One key issue, Straub says, is the possibility of criminal activity or misuse of power by privatized security companies while overseas, noting that security contractors are not held as strictly accountable for their actions as military personnel are. He also points to a sense of distrust that may arise between local populations and privatized security if the individuals are not military representatives of the global community.

While privatized security companies may differ from the military in the way that punishments are handled, Straub says they are no different in their roles as representatives of the countries by which they are sent. Distrust among locals for the security companies could translate to a disruption in relations between countries, particularly when criminal activity is at the root of the distrust.

"Companies like Blackwater have created major problems, not only for the company itself, but for the United States, the hiring state," Straub noted. "That's not to say that peacekeepers themselves, UN peacekeepers, don't commit crimes and human rights abuses either. The difference is that UN peacekeepers are accountable to a specific nation, not a company. When a peacekeeper gets sent back to his or her nation, that person is dealt with by [his or her] own country. And there is legitimacy to that process."

National security affairs doctoral student Cmdr. Dan Straub weighs the benefits and challenges of using private security contractors for United Nations peacekeeping efforts in his upcoming dissertation.

What Straub concluded is that the proper mechanisms are not yet in place for private security companies to be routinely used in peacekeeping operations.

"What I concluded, based on the pros and cons, is that until a unitary policy with regard to the use of private security companies and peacekeeping is developed — and vetted through all of the member states of the United Nations, and approved — private security companies should not be used for peacekeeping."

He stressed that both sides are still trying to figure out the extent to which privatization can be successful, but that it's not something that will simply go away. The policies need to be explored and established if contractors and armed forces are to safely and effectively execute peacekeeping operations.

"Where does the service member's job end, and where does the contractor's job begin?" Straub asked. "It's a continuum, and finding a place on that continuum is right now a moving target." IR

NPS Professor of Applied Mathematics Dr. Frank Giraldo has spent the last three years leading a team of researchers and students in the ground-up development of an all-new scalable, adaptive global weather prediction model, the Nonhydrostatic Unified Model of the Atmosphere, which the Navy has selected as a candidate for use as the multi-agency global model.

Mathematics Faculty, Researchers Develop Candidate Model for Multi-Agency Weather Prediction

By Amanda D. Stein

WITH A FLEET constantly on the move, and a commitment to securing the world's waterways, it's no wonder the U.S. Navy relies on highly-accurate weather prediction models to operate safely and efficiently. For that, the Office of Naval Research has turned to Naval Postgraduate School Applied Mathematics Professor Frank Giraldo and his team of researchers, students and interns who have worked tirelessly for the last three years to provide what could be the best possible model for weather prediction yet.

Giraldo's hard work has paid off, as the Navy has put up his Nonhydrostatic Unified Model of the Atmosphere (NUMA) as a candidate for use as the multi-agency global model. If selected, the model would then be used by, among others, the U.S. Air Force, Department of Energy, and the National Oceanic and Atmospheric Administration. The agencies clearly have stringent requirements for what the adopted model must be able to do, and the decision will likely not be made until around the time the project is slated for completion in 2020.

"I think the idea is that every agency wants to have a hand in the decision, so they all put forth a model that they think has the best chance of being adopted," said Giraldo. "Having our model chosen as the U.S. agency model, I think it would just be too much to ask for. I'm just happy that the Navy wants to use the model for their operations. And that's my number one concern, to be sure that I deliver on the job that I was asked to do."

Giraldo's model draws on existing mathematical Galerkin methods, but uses them in an innovative way, ultimately developing a model that runs longer than current ones available. As Giraldo explained, the model will aim to run "from 30 seconds to 30 days." Traditional large-scale weather models run up to seven days on average.

To put the model to the test, NPS has partnered with the nearby Naval Research Laboratory (NRL), where expert researchers familiar with the desired meteorological outputs examine the model in extraordinary detail.

"We have partnered with the NRL because they are meteorologists and atmospheric scientists," Giraldo continued. "They know what the output should be."

Saša Gaberšek, a Meteorologist for the NRL Marine Meteorology Division, is one of the researchers ensuring Giraldo's methods yield the desired results. He is developing test scenarios to run through the NUMA model.

"The tests are designed to highlight weather-related phenomena in nature which should be accurately depicted by NUMA," Gaberšek explained. "I am also expanding current capabilities of NUMA by incorporating additional descriptions of physical processes that occur in nature into the model."

Along the way in the three-year development process thus far, there have been a number of students and NRC postdoctoral fellows involved in the research. U.S. Army Lt. Col. Joseph Lindquist, a 2010 Ph.D. graduate, now serves as the Senior Operations Research Analyst at the Center for Army Analysis. As part of his dissertation, Lindquist was involved in theoretical research for NUMA.

"My work demonstrated how to apply a special class of boundary conditions to efficiently solve some of the equations that Frank and the team used in the project," said Lindquist. "The boundary conditions that we developed and applied had never been solved using element-based Galerkin methods — a highly accurate and efficient way to solve a set of equations that cannot be solved analytically."

Giraldo has been incredibly pleased with student participation and input, and the progress they have made, but quickly adds that the effort is far from over. The team will be diligently working on the research for the next several years, hoping that the program will be exactly what the Navy is looking for.

"I am proud of this model because it is something I have been working on for a long time," Giraldo said. "And when I say working on it, I mean from the ground up." IR

The summer graduation class was not only one of the largest overall classes, it also included the largest contingent of doctoral graduates in recent school history with nine Ph.D.s awarded during the commencement ceremony.

University's Summer Graduation Class One of the Largest

By MC1 Rob Rubio

WHEN NAVAL POSTGRADUATE SCHOOL President Dan Oliver welcomed the summer graduation class to commencement ceremonies, Sept. 21, he was greeting one of the largest classes in recent history. More than 400 students earned their advanced degrees this past quarter, including nine doctoral graduates.

The ceremony's keynote speaker offered another unique aspect to the class … Vice Adm. Mark I. Fox, Deputy Chief of Naval Operations for Operations, Plans and Strategy (N3/N5), was not only the ceremony's premier speaker, he was also a proud parent with his own son, Lt. Collin R. Fox, a member of this quarter's graduating class completing a master's degree in systems analysis.

"I'm delighted to speak at the Naval Postgraduate School graduation ceremony … I had originally planned to attend the event only as a proud dad, but the opportunity to address the graduates — including one of my sons — of such a prestigious academic institution is a real honor. I completed the Aviation Safety Officer's course at NPS in 1986, and appreciate the enduring partnership between the Navy and the local community. It's always a treat to spend time on the Central California coast."

Fox began his formal remarks noting that commencement marked the culmination of one phase of many lives, and the "beginning of a new and exciting phase filled with hope and anticipation" for the future alumni.

"First and foremost, congratulations to the graduates," he said. "It is appropriate that we pause to recognize your excellence, your discipline and your accomplishment."

He continued, citing his own envy of the graduating class and his desires to attend the institution he has so much respect for when he was a junior officer.

"Of course, all of this would be impossible without the Naval Postgraduate School, an institution which is internationally renowned for academic excellence … a world-class faculty and staff, a world-class institution and a world-class location," he noted.

He recounted the remarkable levels of change that society has seen over the past several decades, but emphasized that advanced education provides the intellectual fuel for that evolution.

"We have seen the greatest increase in prosperity in human history in our lives, how has this happened?" he posed. "Good work in hard science and engineering … tremendous growth in the analog to digital age, and information technologies have come along. But the real driver, I would submit, has been the movement of goods and services around the globe," he commented.

He focused on the global commons, and the important roles of collaboration in protecting this critical driver of human prosperity.

"There are people who wish us ill. There are terrorists, pirates, state actors who would choose to disrupt us," he noted. "Over 30 nations have come together as we speak, in the largest international mine countermeasures exercise which is going on in the 5th Fleet and NAVCENT area of responsibility, to demonstrate the ability to do strictly defensive operations, to demonstrate that we can clear mines and work together and offer a deterrent to aggressive behavior."

Fox continued by connecting these current challenges of the global commons of the sea to the commons of today, and tomorrow. Outer space, cyberspace … while there are no owners of these 'commons,' they are absolutely critical to society's continued advancements, he said, and collaboration will continue to be a key in resolving the complex issues of these domains.

"We will not do things by ourselves in the future. We will work with partners, people who share our values, and work together to accomplish great things," he said.

"It would not surprise me to learn that there are future leaders here today that will take their positions around the world, and work this incredibly complicated and challenging world that we live in founded on a relationship that began in Monterey," he continued.

"Character and integrity are gardens in our lives that must be tended to every day. We are ultimately defined by our courage, character, and integrity," he concluded.

A total of 410 students graduated earning 419 degrees this past quarter, including nine Ph.D.s, one mechanical engineer and 47 international students. IR

Inspired Leadership

During a ceremony in the Pentagon in November, Naval Postgraduate School alumnus Cmdr. Chase D. Patrick will be officially recognized as the Pacific Fleet recipient of the Vice Admiral James Bond Stockdale Award for Inspirational Leadership.

One of the Navy's premier honors, the Stockdale Award is given annually to two naval officers below the rank of captain — one from the Pacific and the other from the Atlantic Fleet — who demonstrate exceptional leadership through recommendations by their peers.

Patrick, a 2001 operations analysis graduate, was recommended for the award following his command of the *USS Chafee* — an Arleigh Burke-class guided missile destroyer stationed at Pearl Harbor, Hawaii. The ship's current commanding officer, Cmdr. Justin Kubu, was responsible for his nomination.

"I felt compelled to recommend Cmdr. Patrick for the award for the record of achievement and culture of excellence on the *Chafee* during his tenure as commanding officer … Much of the success I have enjoyed in command is directly attributable to his lasting leadership," said Kubu.

Patrick's command of his ship and the crew that served on her is a concise example of leadership that serves to inspire others. He focused on individuals, ensuring his crewmembers saw themselves as professionals and were treated accordingly.

"I was committed to a work environment where everyone was treated with dignity and respect … my expectation was that our work environment would radiate professionalism," he said. "To maximize the success of the people assigned to me, I have to make them the very best professionals that I can. If you do that, it has to make you better as an organization."

The *USS Chafee* is home to approximately 350 personnel and is named for Senator John Lester Hubbard Chafee, a Marine veteran of Guadalcanal who also served as the Secretary of the Navy.

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